WHAT IS CLAIMED

1. A counter for probabilistically counting a plurality of items comprising:

a random number generator configured to generate a random number in a range defined by a first value;

a count value register configured to hold a representation of a present count of the items, the count value register including a portion for holding a mantissa of the present count and a portion for holding an exponent of the present count;

an adder connected to the count value register and configured to increment the portion of the count value register that holds the mantissa when the generated random number is less than a second value based on at least one of the plurality of items, and increment the portion of the count value register that holds the exponent when the portion that holds the mantissa overflows; and

an update component connected to the count value register and configured to recalculate the first value as a higher value when the exponent is increased by the adder.

2. The counter of claim 1, further comprising:

a comparator connected to receive the random number and the second value and configured to compare the random number to the second value and signal the adder to increment the portion of the count value register that holds the mantissa when the random number is less than the second value.

3. The counter of claim 2, further comprising:

a first register connected to the output of the random number generator and configured to store the random number and supply the random number to the comparator; and

a second register configured to store the second value and supply the second value to the comparator.

4. The counter of claim 1, wherein the range defined by the first value for generating the random number is between zero and the first value.

5. The counter of claim 1, wherein the present count of the counter is a function of the values stored in the mantissa portion and the exponent portion of the count value register, the function being defined by:

$$2^n + m \bullet 2^{n-N_m},$$

where n is the value in the exponent portion, m is the value of the mantissa portion, and N_m is the size of the mantissa portion.

6. The counter of claim 1, wherein the second value is based on a size of the at least one item.

7. The counter of claim 1, wherein the portion of the count value register that holds the mantissa and the portion of the count value register that

holds the exponent are implemented as adjacent bits of a memory device that together comprise the count value register, the adder incrementing the portion of the count value register that holds the mantissa by incrementing the count value register.

8. The counter of claim 1, wherein the adder increments the portion of the count value register that holds the mantissa by one.

9. The counter of claim 1, wherein each counted item is a packet in a network.

10. The counter of claim 1, wherein the update component recalculates the first value as

$$2^{n-N_m},$$

where n is the value in the exponent portion and N_m is the size of the mantissa portion.

11. A method of probabilistically counting a series of items comprising:

generating a random number in a range defined by a first value;

increasing a count value of the items when the generated random number is less than a second value; and

increasing the range of the generated random number by increasing the first value when the count value has been increased a predetermined amount.

12. The method of claim 11, wherein the range of the random number is between zero and the first value.

13. The method of claim 11, wherein the counted items are dropped packets in a network.

14. The method of claim 13, wherein the second value is based on the size of the dropped packet.

15. The method of claim 11, wherein the count value is implemented as an exponent and a mantissa, the first value being incremented when the mantissa overflows.

16. The method of claim 15, wherein the first value is increased by recalculating the first value as

$$2^{n-N_m},$$

where n is the value in the exponent and N_m is the size of the mantissa.

17. The method of claim 15, wherein the count value is

$$2^n + m \bullet 2^{n-N_m},$$

where n is the value in the exponent, m is the value of the mantissa, and N_m is the size of the mantissa.

18. A method of probabilistically counting a series of packets, the method, for each packet in the series, comprising:

storing a size of the packet;

generating a random number between zero and a first value;

increasing a count value of the packets when the generated random number is less than the size of the packet, the count value being stored as a combination of an exponent value and a mantissa value; and

recalculating the first value when the increasing of the count value of the packets causes the mantissa to overflow.

19. The method of claim 18, wherein the count value stored as the combination of an exponent value and the mantissa value is given by:

$$2^n + m \bullet 2^{n-N_m},$$

where n is the value in the exponent, m is the value of the mantissa, and N_m is the size of the mantissa.

20. The method of claim 18, wherein increasing the count value of the packets includes increasing the value of the exponent when the mantissa overflows.

21. The method of claim 18, wherein increasing the count value includes increasing the count value by one for each packet.

22. The method of claim 18, wherein the first value is recalculated as

$$2^{n-N_m},$$

where n is the value in the exponent and N_m is the size of the mantissa.

23. A network device comprising:

a routing engine configured to maintain at least one routing table that stores routing information for packets in the network; and

a packet forwarding engine configured to receive incoming packets and, based on information in the routing table, forward the packets to a next device in the network, the packet forwarding engine further including a rate-limiter for dropping incoming packets when the input bandwidth of the incoming packets is greater than a maximum capacity of the network device, the rate-limiter including a counter for counting the number of dropped packets, the counter further comprising

a random number generator configured to generate a random number in a range defined by a first value;

a count value register configured to hold a representation of a present count of the number of dropped packets, the count value register including a portion for holding a mantissa of the present count and a portion for holding an exponent of the present count;

an adder connected to the count value register and configured to increment the portion of the count value register that holds the mantissa when the generated random number is less than a size of the dropped packet, and increment the portion of the count value register that holds the exponent when the portion that holds the mantissa overflows; and

an update component connected to the count value register and configured to recalculate the first value as a higher value when the exponent is increased by the adder.

24. The network device of claim 23, wherein the network device is a network router.

25. The network device of claim 23, wherein the counter further comprises:

a comparator connected to receive the random number and the size of the dropped packet and to compare the random number to the size of the dropped packet and signal the adder to increment the portion of the count value register that holds the mantissa when the random number is less than the size of the dropped packet.

26. The network device of claim 24, wherein the counter further comprises:

a first register connected to the output of the random number generator and configured to store the random number and supply the random number to the comparator; and

a second register configured to store the size of the dropped packet and supply the size of the dropped packet to the comparator.

27. The network device of claim 23, wherein the range defined by the first value for generating the random number is between zero and the first value.

28. The network device of claim 23, wherein the present count of the counter is a function of the values stored in the mantissa portion and the exponent portion of the count value register, the function being defined by:

$$2^n + m \bullet 2^{n-N_m},$$

where n is the value in the exponent portion, m is the value of the mantissa portion, and N_m is the size of the mantissa portion.

29. The network device of claim 23, wherein the portion of the count value register that holds the mantissa and the portion of the count value register that holds the exponent are implemented as adjacent bits of a memory device that together comprise the count value register, the adder incrementing the portion of the count value register that holds the mantissa by incrementing the count value register.

30. The network device of claim 23, wherein the adder increments the portion of the count value register that holds the mantissa by one.

31. The network device of claim 23, wherein the update component recalculates the first value as

$$2^{n-N_m},$$

where n is the value in the exponent portion and N_m is the size of the mantissa portion.